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# THE JOURNAL

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## ROYAL ASTRONOMICAL SOCIETY OF CANADA

VOL. XIX, No. 1 JANUARY-FEBRUARY, 1925 WHOLE No. 145

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THE JOURNAL
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ROYAL ASTRONOMICAL SOCIETY
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VOL. XIX JANUARY-FEBRUARY No. 1

# THE ORBITS OF FOUR SPECTROSCOPIC BINARIES

By W. E. HARPER

THE following summary of the investigation of four spectroscopic binaries may be of interest to readers of the JOURNAL. One has a period of about three days while the other three are long.

The data of the stars themselves are given in the table immediately following whilst the orbital elements are collected at the end of the paper.

STARS INVESTIGATED

| Star | $\alpha$ 1900 | $\delta$ 1900 | Vis. Mag. | Type |
|---|---|---|---|---|
| | h m | ° ′ | | |
| Boss 804 | 3 25.3 | +12 36 | 4.28 | G9 |
| Boss 1190 | 4 55.5 | +40 56 | 3.94 | K+B |
| Boss 1452 | 5 46.0 | +59 52 | 5.26 | A1 |
| Boss 5192 | 20 11.2 | +23 12 | 5.38 | G7 |

*Boss 804*

This star, which is 5 Tauri, was announced a binary by the Lick observers from observations made during the years 1897 to 1907. Other velocities were obtained by Küstner, by the Mount Wilson observers and by the writer while at Ottawa. These early

observations have naturally helped to define the period but apart from that they have not been used. Twenty-six single-prism spectra made at Victoria during the years 1919 to 1924 and covering two cycles of the long period of 960 days have formed the basis for the determination of the elements. The plates were measured on the comparator against Arcturus as a standard and the resulting probable error of a plate is ±0.9 km. per sec.

*Boss 1190*

This star, known as *zeta* Aurigae, was also announced a binary from the Lick Observatory in 1908. Miss Maury at Harvard had previously classified the spectrum as composite suggesting that it consisted of a K-spectrum and one of B-type. Our own plates bear out this view and in general the spectrum has a "washed out" appearance due to the overlapping. However, one plate taken at the time when the K-type star was in its orbit nearest the sun has a spectrum markedly different in that this "washed out" appearance is absent, the absorption lines being particularly intense. The probability of an eclipse in an orbit where the period is 973 days is necessarily small but some explanation is demanded by the change in the spectrum. The plates were likewise measured on the spectrocomparator against Arcturus and the probable error of ±1.0 km. per sec. was satisfactorily low. The star will be kept under observation here.

*Boss 1452*

Twenty-five spectrograms obtained with the single-prism were made the basis of a determination of the orbital elements. The measures depend for the most part on four lines, the two hydrogen lines λ4340 and λ4101, the magnesium λ4481 and the calcium λ3933. True, there are numerous other metallic lines but in general they are too faint and elusive to measure excepting occasionally λ4549 and λ4233. The measures were made upon the micrometer engine with a resulting probable error of a plate of ±3.1 km. per sec.

*Boss 5192*

Twenty-seven single-prism spectra of this star measured on the comparator against Arcturus as a standard give fairly reliable

values of the orbital elements although the plates are not as evenly distributed over the period of 251 days as could be desired. The probable error of a plate is ±1.0 km. per sec.

TABLE OF ELEMENTS

| Element | Boss 804 | Boss 1190 | Boss 1452 | Boss 5192 |
|---|---|---|---|---|
| P | 960 days | 973 days | 2.93317 days | 251 days |
| $e$ | .397 | .411 | .030 | .042 |
| $\omega$ | 326°.32 | 330°.13 | 359°.25 | 121°.00 |
| $\gamma$ | +14.18 km. | +10.73 km. | −3.86 km. | −23.75 km. |
| K | 8.25 km. | 23.78 km. | 76.02 km. | 26.99 km. |
| T | 2,414,889.565 | 2,415,122.471 | 2,421,938.356 | 2,423,415.850 |
| $a \sin i$ | 99,955,000 km. | 294,300,000 km. | 3,064,800 km. | 93,072,000 km. |

Dominion Astrophysical Observatory,
Victoria, B.C.
December, 1924.

# METEOROLOGY AT THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE INTERNATIONAL MATHEMATICAL CONGRESS.

By J. Patterson

The meetings of the British Association for the Advancement of Science and the International Mathematical Congress brought together the most distinguished gathering of Meteorologists that has ever assembled on this continent: it included the Ex-President of the International Meteorological Committee, the distinguished heads of the American, Canadian and Norwegian Services and many of the higher officials from these countries and Great Britain. The visitors from overseas were never idle and on the voyage across when most people consider it a time for relaxation and rest they were busy on meteorological problems. Messrs. J. Bjerknes and M. A. Giblett prepared daily forecasts from the observations received by wireless on board the boat while Messrs. L. F. Richardson and F. J. W. Whipple conducted a series of experiments in connection with the change of temperature with height over the ocean; the latter also made a careful examination of the temperature of the air as recorded in the thermometer shelters which are provided by the London Meteorological office and he found that it was exceedingly difficult to get an exposure except on the bridge that would give accurate air temperature. In the position where the shelters are generally placed the observations may be as much as a degree in error. This investigation will undoubtedly lead to greater attention being paid to the exposure of the thermometers on board ship, if accurate observations are to be obtained.

At the sessions of the British Association and the Mathematical Congress almost all branches of Meteorology were discussed from the conditions that would prevail if the earth went dry to the artificial production of rain and the reforming of the calendar.

It is, of course, impossible that the atmosphere should become void of water vapour, but when the subject is considered it is soon

realized that one of the most fundamental problems in meteorology is presented under the somewhat humorous title "If the Earth went Dry". If meteorologists can get a clear conception of what the weather would be in an atmosphere devoid of moisture and thus of discontinuities they will be in a much better position to construct the physical basis that produces the weather in our atmosphere as we have it. Sir Napier Shaw treated the subject in his own masterly style, calling special attention to the fundamental part that water vapour plays in the atmosphere, for it not only furnishes the earth with humidity, hail, snow and rain, but it also provides the energy for the processes that produce them. One of the conclusions that he reached was that it would require a wind of about 175 miles an hour to maintain a steady state of temperature on a polar slope exposed to prolonged nocturnal radiation; we would all agree with him when he stated that he felt justified in calling such a wind a dust blizzard. The paper is given in full in *Nature* for November 8, 1924.

Norway was represented at the meetings by Prof. V. Bjerknes and his son Mr. J. Bjerknes. The former is one of the outstanding mathematical meteorologists of the day and his son puts into practice the problems that he works out. They form a very remarkable combination, and already they have added very materially to our knowledge of the weather: their work on the theory of "The Polar Front" has opened up a new field that promises an abundant harvest, and in their papers and discussions they showed how mathematics is being applied to forecasting.

While dealing with the subject of forecasting one must not omit to mention the valuable study that Sir Frederic Stupart is carrying on in connection with the character of the Canadian winters and the atmospheric conditions that produce them. He finds that in normal seasons North Pacific cyclonic areas usually move south-eastward with their centres well off the coast until at about the latitude of Northern British Columbia they enter the continent, while anticyclonic conditions of moderate intensity with low temperature prevail in the Yukon and on the MacKenzie River. In certain years the Pacific cyclonic areas are less intense and enter the continent farther south, while great anticyclonic developments occur in the

far north and sweep south eastward over Canada, accompanied by severe cold waves which not infrequently reach the Atlantic coast. These conditions lead to abnormally cold winters in Canada. In other years the Pacific cyclonic areas appear to be of such intensity that they force their way into the continent in high latitudes and actually prevent the formation of anticyclonic areas and their concomitant low temperatures. These conditions lead to mild winters in Canada. There appears to be a connection between the temperature of the North Pacific ocean and the Japanese Current and the characters of the winters in Canada, and the Meteorological Service is investigating the subject.

Prof. C. F. Marvin, Chief of the United States Weather Bureau, has been making a detailed study in periodicities in weather and in the course of his investigations he has gotten into difficulties in regard to the calendar and has become an enthusiastic and strong supporter of the movement to reform it. The calendar was devised to suit the whims of an old Roman Emperor and so we have a month with four weeks plus 0, 1, 2, or 3 days. Such a calendar absolutely prohibits orderly and rational meteorological summaries of meteorological data. The month is too long and it cannot be subdivided into shorter integral periods so that the only way to get a rational system is to reform it and have 13 months with four weeks each and every year beginning on the same week day. The odd days being suitably disposed of. Prof. Marvin has already made an attempt to reach this condition by having his summaries made for weekly periods with the first week in the year beginning on the first of January.

Dr. W. J. Humphreys, of the United States Weather Bureau, Mr. J. Patterson of the Canadian Service and Sir Napier Shaw dealt with some of the problems of the upper air. Dr. Humphreys reported that in his investigation of the winds he found that they increase in velocity for the first 1,500 feet above the surface, then decrease slightly through the next 1,000 feet, after which they remain roughly constant up to 10,000 feet, after which they increase in proportion to the decrease in density. Mr. Patterson described the work that has been carried on in Canada since 1910. The observations to date indicate that the stratosphere (the region of constant temperature) is warmer and lower in winter than in summer. He

also stated that attempts were being made to study the structure of the atmosphere in the Chinook winds of Alberta, but so far no instruments have been recovered that were sent up from Calgary in Chinook winds.

It may seem perhaps a simple and easy matter for meteorologists to arrange a system of absolute units in which to give the results of upper air observations, but as a matter of fact it is proving one of the most puzzling problems that has to be solved. It has been discussed at all the meteorological conferences of recent years and is still far from solution on account of the expense involved and the many countries that are interested. Sir Napier Shaw, the Dean of Meteorology and Chairman of the Committee on the Upper Air, discussed the problem at considerable length at an informal meeting of meteorologists in the office of Sir Frederic Stupart in connection with a paper that he was giving to the International Mathematical Congress. Sir Napier elaborated on a new system that he is proposing by which he represents on a chart a diagram of temperature and potential temperature in such a way that it gives at once the amount of energy available in the atmosphere and thereby showing whether or not there is sufficient energy to produce rain, and if so, the approximate intensity. The system offers a simple and unique way of representing upper air data in a way that should be of very great value in the study of the atmosphere.

Radiation, the source from which all the energy that produces the weather is derived, was also discussed by Prof. H. H. Kimball of the U.S. Weather Bureau, who has been measuring the intensity of the radiation received from the sun and from skylight. Colour temperatures of sunlight and skylight and the spectrum energy curves of radiation from the sun and sky have been utilized to determine approximately the spectrum energy curve of the total radiation received on a horizontal surface and its variation with atmospheric transmissibility and the solar zenith distance.

Mr. F. J. W. Whipple of the London Meteorological Office gave a very beautiful experimental illustration of the green flash that appears under favourable conditions at sunset. It is believed to be due to the simultaneous action of dispersion and absorption and his experiment was in confirmation of this view. He also took up the

riddle of the diurnal variation of pressure. This daily variation is very pronounced in tropical regions but is smaller and generally masked by the larger movements in extra tropical regions. The problem is still unsolved but he hoped that an analysis of the barograms that are in existence would give valuable information.

Mr. L. F. Richardson, who has been making a special study of turbulence in the atmosphere and who has worked out from theory a criterion for the increase of turbulence, applicable at a height in the free air great compared with the irregularities of the ground, has also been investigating this effect among trees; he described the effect of turbulence on the temperature gradient among trees by using a pair of thermo-couples at different heights and used a Dines' pressure tube anemometer to get the gustiness.

The production of rain by artificial means has long fascinated many people and even Sir Oliver Lodge is reported as having expressed his belief in its possibility, but had he heard Dr. Humphreys' paper on rain-making, in which all the various schemes were analyzed and found wanting, the opinion might not have been uttered. All those schemes, such as the production of loud noises, the use of chemicals, mechanical or forced convection, fog collecting schemes, dusting the sky, spraying liquid air on the clouds or sprinkling clouds with electrified sand, are full of meteorological interest and it requires a very thorough knowledge of the principles underlying the production of rainfall to show just why all these schemes fail from a commercial sense. Dr. Humphreys, in his own happy manner, showed that all these schemes are beyond the power of man and that this is one of the things he cannot control.

The problems directly affecting the meteorologists were discussed at a delightful informal meeting in the office of Sir Frederic Stupart, at which there was renewed discussion of many of the papers given at the general meetings and for which there was no time. At this meeting Mr. L. F. Richardson suggested that for mathematical treatment of weather problems stations should be established on a system of rectangular co-ordinates instead of the haphazard methods at present adopted. He felt certain that such a network of stations would yield very valuable results; it was suggested that he make out a system of stations on this basis.

Mr. Ferguson of the U.S. Weather Bureau, exhibited one of his latest instruments for obtaining the temperature, pressure and humidity in the upper air by means of balloons. He has succeeded in reducing the weight of the instrument to much less than half that of the old instrument and at the same time by his method of using a link movement he has almost doubled the scale. These instruments are unlike the Dines' in that they have a rotating drum with clockwork whereas the Dines' instrument has none and is thus much smaller, and lighter.

The measurement of ocean temperatures and the methods adopted for the North Pacific were described by Mr. Patterson. He has found that the mercurial thermograph is the most satisfactory for obtaining the sea water temperatures. The bulb is inserted in the intake to the condensers, in a copper tube. This is absolutely necessary otherwise the tube is quickly corroded and destroyed. At first an ordinary iron steam pipe was used to house the bulb but it was soon destroyed by the action of the seawater. The recording mechanism is placed in any convenient position in the engine room. The engineers on the boats co-operate very willingly in the work as such thermographs are of great assistance to them as it enables them to see the temperature at all times and the records are now explaining many peculiarities that they could not understand formerly. This work is being carried on as part of an investigation into the effects of the temperature of the North Pacific on the winter conditions in Canada. In this connection Dr. G. F. McEwen of the Scripp's Institution, California, gave to the International Mathematical Congress an important contribution to the problem by presenting a mathematical theory of temperature gradients in bodies of water having only a convective circulation due to evaporation and the absorption of solar radiation with special reference to the Pacific off Southern California, from which it is hoped to obtain valuable information in regard to ocean currents.

# THE TOTAL SOLAR ECLIPSE OF JANUARY 24, 1925

By C. A. CHANT

As far as Ontario is concerned, the recent eclipse was a great disappointment. That portion of the province included in the path of totality includes a million or more people, and the interest shown in the phenomenon was intense.

The University of Toronto had erected instruments at a hamlet known as Long's Corners, situated about four miles south of Hamilton, on the same level as the top of the Hamilton Mountain. The distance from the University is almost fifty miles by a good cement highway.

The apparatus was prepared at the University, and one week before the eclipse, was loaded on a motor truck and taken directly to the site. There was considerable snow on the ground, but the roads were quite passable. Some weeks before this a shelter had been built to receive the instruments.

They consisted of (1) a 45-foot camera, mounted horizontally, with a lens 5 inches in diameter and using plates 14×17 inches in size. This was served by a coelostat bearing a 12-inch plane mirror made from pyrex glass. (2) A camera containing four lenses each of 42 inches' focal length and mounted on a single metal plate. Before two of these lenses were placed Nicol prisms, while in screens placed before the photographic plates colour filters were placed. It was hoped to secure photographs of the corona in polarized light and by light of various colours. (3) By means of a Zeiss tessar, aperture f 6.3, focal length 36 cm., with a transmission grating before it, an attempt was to be made to secure the spectrum of the "flash" at second and third contacts, and also the spectrum of the corona between these contacts. The latter two cameras were mounted on an axis which was rotated by a long arm attached to a clock cord in the way ordinarily used by the Lick Observatory on their eclipse expeditions.

In addition to the above, the contacts were to be observed by Mr. R. Meldrum Stewart, of the Dominion Observatory, Ottawa.

The present writer and his colleague, Dr. R. K. Young, began to erect the instruments on the 17th and by rather strenuous labour, sometimes with the temperature near to zero, they were set in place and adjusted by Thursday nòon, January 22nd. On Wednesday, the 21st, Messrs. J. P. Henderson and F. Harrison, and also Messrs. C. A. French and Madill, of the Dominion Observatory, arrived. The former arranged wireless apparatus to observe any "fading out" of the signals during the total phase, and also to secure accurate time for the camp; the latter set up their magnetic instruments in a tent in order to observe any change in the magnetic condition of the earth during the eclipse.

On Friday Messrs. H. G. Hanley, W. I. Wells, F. Hogg, J. H. Horning, W. T. Grant and J. W. Melson arrived from Toronto to act as assistants in handling the instruments; and during the day there were many rehearsals until at last all were confident that the programme could be carried through without a mistake. It was found that four plates could be obtained with the 45-foot camera, 5 plates (20 pictures) with the polarization camera, and 3 with the spectrograph.

On Friday also arrived Prof. G. R. Anderson, of the University of Toronto, and five assistants with a photometric equipment for measuring the intensity of sky-light during the eclipse. Their work was a part of the project of the American Society of Illuminating Engineers to obtain observations along the path of totality.

During this day two motion picture outfits arrived, one from the Ontario Government Bureau, the other from the Pathescope Company. A fast camera was to be used for photographing the shadow bands. A full record of the operations of the camp was also to be made on the films.

As the week went on the prospects for a clear morning improved. On Thursday cold weather arrived and this lasted over Friday, with fine weather. It was hoped and believed that the area of high pressure would last over the camp until after the eclipse, but at 5 a.m. of Saturday the clouds came and they did not break until the eclipse was over.

Great numbers assembled to view the eclipse, but all there was to do was to shiver in the bitter south-west wind which blew. As the time for totality approached the darkening of the landscape

and the apparent approach of a great storm from the west were very impressive, but soon it was over and the light returned more rapidly than it had faded.

The astronomers, who had laboured longest and hardest, did not get a single picture and, along with the multitude of citizens who had so earnestly looked forward to seeing the wonderful corona, were greatly disappointed. The wireless experimenters noticed positive changes in the reception of the signals during the eclipse; the measurements of the sky illumination were also made; and the magnetic observations were also carried through. It is hoped to publish a summary of the results in a later issue.

At Stratford and at some other places in Perth County, I am informed, the clouds broke at the critical time and allowed a view of the corona, but over all the rest of the shadow path in Ontario and also beyond it to the west clouds obscured the sun. On the other hand, the cold wave still covered New York and Connecticut and the Atlantic Ocean, and many excellent observations were made, while the great population in these eastern states had the sight of their lives.

# A SHORT METHOD OF OBTAINING THE AZIMUTH OF POLARIS

By J. F. FRÉDETTE

In field astronomy the azimuth of the Pole Star is a problem of such frequent occurrence that any new method designed to facilitate its computation is always hopefully looked into by the surveyor or engineer.

A number of tables and graphic solutions have come into use and have met with a measure of success depending on the degree of accuracy sought by the user. None of these, as far as the writer is aware, are adequate when the azimuth is required within a few seconds of arc. In all such cases, the field astronomer must generally resort to computation by the rigorous formula

$$\tan Z = -\frac{\tan P \sec L \sin t}{1-\tan P \tan L \cos t} \qquad (1)$$

where $Z$, $P$, $L$ and $t$ are the azimuth, polar distance, latitude and hour angle respectively. But the use of this formula entails considerable labour.

Since the values of $Z$ and $P$ are always small, they may be expressed in seconds of arc and the following expansion formula used for $Z$

$$Z = -P \sec L \sin t - \tfrac{1}{2} P^2 \sin 1'' \sec L \tan L \sin 2t$$
$$-\tfrac{1}{3} P^3 \sin^2 1'' \sec L \sin t[(1+4 \tan^2 L) \cos^2 t - \tan^2 L] \qquad (2)^*$$

in which series the terms after the third become negligible. Transforming and factoring, we get

$$Z = -P \sec L \sin t[1+P \sin 1'' \tan L \cos t$$
$$+\tfrac{1}{3} P^2 \sin^2 1'' \{(1+4 \tan^2 L) \cos^2 t - \tan^2 L\}] \qquad (3)$$

or putting "a" for $P \sin 1'' \tan L \cos t$ and "b" for $\frac{1}{3} P^2 \sin^2 1'' \{(1+4 \tan^2 L) \cos^2 t - \tan^2 L\}$ we now have

$$Z = -P \sec L \sin t\,(1+a+b) \qquad (4)$$

*This is the formula used in the computation of the "Astronomical Field Tables" issued periodically by the Surveyor-General's office.

Again, the term "$b$" is very small as compared with $(1+a)$ and without appreciable error, (4) may be further factored and expressed in the more convenient form

$$Z = -P \sec L \sin t \,(1+a)\,(1+b) \qquad (5)$$

A mean value of $P$ is all that is necessary in computing "$b$" and a small diagram (Fig. 1) giving log $(1+b)$ directly to one unit in the fifth place may serve for a life-time.

Log $(1+a)$ may also be readily obtained from a graphical construction about $11 \times 15$ inches, shown in Figure 2, with the same interpolation facility as in five-figure logarithmic tables.

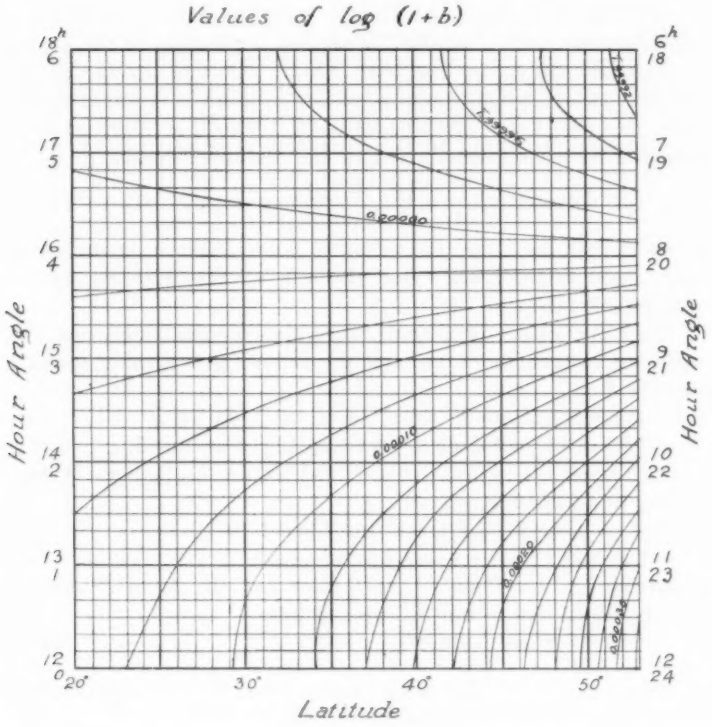



Fig. 1

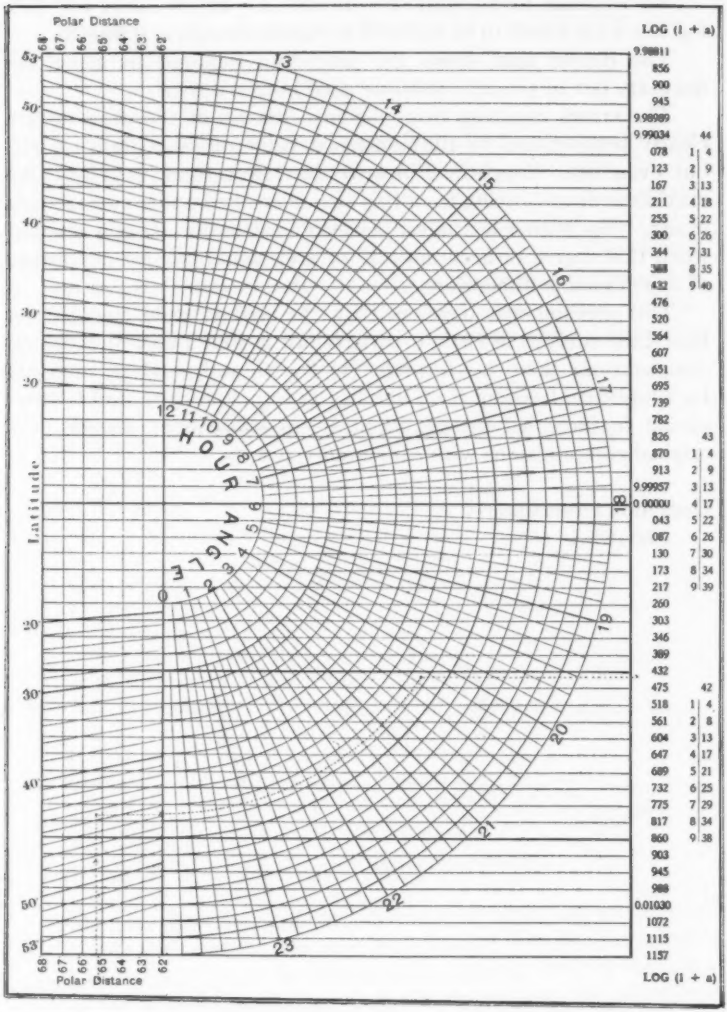

Polar Distance
68 67 66 65 64 63 62
53 50 40 30 20 10 0 10 20 30 40 50 53
Latitude
HOUR ANGLE
12 11 10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23
LOG (1 + a)
9.98811 856 900 945
9.98989
9.99034 078 123 167 211 255 300 344 388 432 476 520 564 607 651 695 739 782 826 870 913
9.99957
0.00000 043 087 130 173 217 260 303 346 389 432 475 518 561 604 647 689 732 775 817 860 903 945 988
0.01030 1072 1115 1157
44 43 42
1 4 2 9 3 13 4 18 5 22 6 26 7 31 8 35 9 40
1 4 2 9 3 13 4 17 5 22 6 26 7 30 8 34 9 39
1 4 2 8 3 13 4 17 5 21 6 25 7 29 8 34 9 38
Polar Distance
LOG (1 + a)

Fig. 2

For example, for the data: $P = 65' 18''$, $L = 44° 30'$, and $t = 3^h 45^m$, log $(1+a)$ is found to be 0.00445 (computation gives 0.00448).

The dotted line shows the procedure followed in using the drawing, but in practice this line need not be drawn.

The errors resulting from the inaccuracies of the drawing are clearly proportional to the numerical value of the azimuth itself, but even near elongation, in latitudes lower than, say, 53°, the maximum errors arising from this source are well under two seconds of arc. For higher latitudes, however, a situation is soon reached when this degree of accuracy (2″ of arc) would call for a drawing of objectionable dimensions.

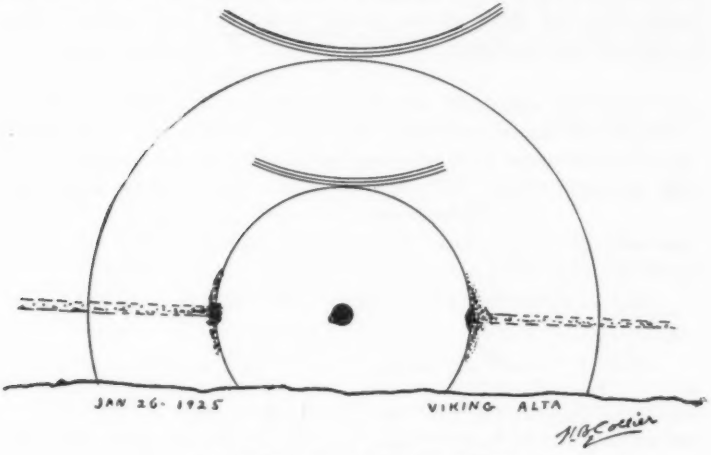
This method was developed by the writer while engaged on Base-Line surveys in 1915, in an attempt to find a way of checking computations done by formula (1) by an independent method. Its simplicity, freedom from liability to errors of signs, and labour-saving features led me to adopt it, in subsequent seasons, for original computations with satisfactory results.

Dominion Observatory,
Ottawa.

## A SOLAR HALO SEEN AT VIKING, ALBERTA

By H. B. COLLIER

I enclose a sketch of a halo which appeared on January 26 in the eastern sky. Temperature was well below zero with the air filled with tiny ice crystals. Without instruments that would accurately measure, I was forced to use an improvised protractor made of cardboard, with pins protruding for sights. Therefore I hesitate to assert unreservedly that the *Encyclopedia Britannica* is in error regarding the diameter of the first circle about the sun. My edition places this at $22\frac{1}{2}$ degrees diameter, while this should be radius to accord with my observations.




A Solar Halo seen at Viking, Alberta

This halo appeared noteworthy on account of the presence of the double circle about the sun and with it the double band of prismatic colours. The mock suns or parhelia were of the usual orange-red flaming nature, so bright as to prevent the naked eye

gazing longer than one or two seconds. Extending back of the parhelia were bands of white, some four or five degrees in diameter, and parallel to the horizon.

Thus in these occasional demonstrations of nature's beauty do I receive some compensation for the temperatures of 30, 40, 50 sub-zero that hit us every winter. Of course, we never feel it, like the Vancouver citizens claim the rain does not wet you out there.

Viking, Alberta,
Jan. 29, 1925.

## VALUABLE INVESTIGATIONS ON MARS

The recent close opposition of Mars was well used by astronomers in the United States and in the *Publications of the Astronomical Society of the Pacific* for October last five interesting papers appear. They are: Photographs of Mars Made with Light of Different Colours, by W. H. Wright; Observations of Mars Made at the Lowell Observatory, by E. C. Slipher and V. M. Slipher; Visual and Photographic Observations of Mars, by R. Trumpler; Radiation Measures on the Planet Mars, by E. Pettit and S. B. Nicholson; and Radiometric Measurements on Mars, by W. W. Coblentz and C. O. Lampland. It may also be mentioned that in the same number is a paper by J. A. Pearce on "Oppositions of the Planet Mars," in which it is stated that although at the opposition of 1926 on November 4 the planet will be eight million miles farther from the earth than it was in 1924, yet on account of its more northerly declination it will be more favourably situated for northern observations.

One of the striking features in the drawings made by Dr. Trumpler is the number of straight markings which he records—many more, I believe, than any previous Lick observer has seen. The drawings are very similar to those by Lowell made in 1892 and 1894 and published in his first book on Mars.

An excellent summary of this recent work is given by Professor H. N. Russell in the *Scientific American* for February, which we take the liberty to reproduce herewith. It is entitled:

### New Facts About Life on Mars

The time is ripe to speak of some very interesting work that has been done during the recent opposition of Mars, and is now published. The great western observatories were well prepared for the favourable situation of the planet last summer, and extensive series of observations were made.

Drawings, based on direct visual observations, and photographs on fine-grained plates, were made by Slipher at the Lowell Observatory and by Trumpler at the Lick Observatory. Both observers agree with one another and with the work of previous

years in finding numerous nearly linear dark markings or "canals" crossing the brighter and redder portions of the surface of the planet, in seeing an abundance of detail within the large darker areas, and in the conclusion that the photographs, although they cannot be made fine-grained enough to reveal the more delicate detail which is directly visible, afford conclusive and impersonal evidence of the reality of the stronger canals, as well as of the more conspicuous features.

Dr. Slipher's series of photographs show in a very beautiful and convincing way how the dark regions grow larger and deeper in hue as the polar caps wane and the Martian spring advances; while on one of the photographs the dark markings on the opposite hemispheres, where autumn is changing to winter, are seen to fade.

Further information is secured by photographing the planet through screens of different colours—using, of course, a reflecting telescope, which is perfectly achromatic, and special photographic plates. The images obtained with violet light show the polar caps very strongly but only traces of the other markings. With deep red light the dark markings show great contrast and the polar cap is hardly brighter than some other regions. Photographs taken with intermediate colours show a gradation between these extremes.

Dr. Wright, of the Lick Observatory, gives a reasonable explanation of these differences, as due to the presence of a fairly dense atmosphere around the planet. Any atmosphere, whether on earth or on Mars, must scatter sunlight and shine as our blue sky does. If the atmosphere is foggy or hazy it will scatter all colours almost alike, but if it is clear or nearly so it scatters the short waves very much the most strongly, producing the familiar blue haze. For this reason a photograph of a landscape taken on an ordinary plate with violet light may fail to show a distant mountain, while one taken through a screen of yellow or red reveals it.

Dr. Wright concludes, also, that it is probable that clouds or haze hang over the polar cap and that these account for at least a part of its brightness when photographed with violet light. He also advances with due discretion the opinion that the planet's atmosphere may be as much as a hundred miles in depth. This

suggestion is based on the fact that the image of the planet, photographed with the violet rays, appears larger than does the image photographed with red rays. Further tests are necessary to determine how much of the observed effect may arise from the spreading of the photographic image on the plates. In the present writer's judgment, it is probable that the actual height of the atmosphere may turn out to be less but this does not detract one whit from the value or importance of Dr. Wright's work.

Most interesting of all—because bearing most directly upon the vexed question of the temperature of Mars, are the measurements of the heat received from the planet. Such observations have been made at the Lowell Observatory, by Coblentz and Lampland and also at Mt. Wilson, by Pettit and Nicholson, both pairs of observers using the exceedingly delicate vacuum thermocouples which were described in these columns a year or two ago. The heat-receiving surface is so small that it is possible to set it at will upon different parts of the planet's surface.

Moreover, the heat may not only be measured, but analyzed. By the use of screens of various materials—water, glass, fluorite, rock-salt—it is possible to cut off more or less of the invisible long-wave radiations and to find out what proportion of the heat is transmitted by one of these screens and is stopped by the one preceding on the list.

In this way the heat which is merely reflected by the planet, and which is almost all in the short wave-lengths, can be distinguished from the heat which is given out by the planet's own warm surface. Knowing the amount of this latter heat, and the size and distance of the planet, the temperature of the radiating surface can be calculated. A second and nearly independent determination of the temperature can be made by comparing the relative proportions of the planetary radiation which are transmitted by the various screens. Allowance for the absorption of radiation in the earth's atmosphere is necessary, and has been carefully made.

The results obtained at the two observatories are in excellent agreement. For the centre of the planet's disk—a region in the Martian tropics under a vertical sun—the temperature is found at Mt. Wilson to be 7 degrees Centigrade, or 45 degrees Fahrenheit, while the values obtained at Flagstaff range from 7 degrees to 18 degrees Centigrade, or 45 degrees to 65 degrees Fahrenheit.

Near the planet's limb, where the sun is rising or setting, the temperature comes out −13 degrees Centigrade or 9 degrees Fahrenheit from the Mt. Wilson observations, while the region of the polar cap gives about −70 degrees Centigrade or 90 degrees below zero Fahrenheit.

These temperatures are calculated on the assumption that the planet's surface is a good radiator, which is probably not far from the truth for the surface in general. The white polar caps are probably poor radiators, in which case their actual temperatures must be higher than the low value here given.

The outcome of these measures is apparently quite definite and we may regard it as very probable that the temperature on Mars' surface runs well above freezing at mid-day near the equator.

This makes it quite possible that vegetation may exist upon the planet, and Dr. Slipher says, with reason, that the seasonal changes in the dark markings all obey the law of change that we should expect of vegetation.

On the other hand, the very low polar summer temperature found at Mt. Wilson looks unfavourable to the belief that the polar caps are composed of snow (on which all else depends). However, for reasons already stated, the temperature of this region cannot be regarded as finally settled.

Whether vegetation actually does cover much of the planet's surface is harder to determine. If the chlorophyll of the leaves of Martian vegetation is similar to that of terrestrial plants, it should reflect deep-red light strongly and the dark markings should show bright when photographed through a suitable screen. Nothing of this sort has been observed but the failure of the test is not conclusive, for many terrestrial plants do not show this peculiarity.

The one crucial test appears to be the presence or absence of free oxygen in the atmosphere of Mars. By means of the ingenious method invented independently by Lowell, Campbell and St. John, the spectrum lines due to absorption in the planet's atmosphere can be got clear of those originating in our own.

Observations on Mars may be under way even now. When their results are announced, we will have the best evidence that seems at present to be attainable. If oxygen is there, the presence of vegetation will be decidedly probable.

## REVIEW OF PUBLICATIONS

*Histoire de l'Astronomie*, by F. Boquet, Astronomer at the Paris Observatory. $5\frac{1}{2}\times 9$ in., 509 pages. Paris, Payot, 1925. Price (paper), 25 fr.

The author of this work states that it is not intended for the professional astronomer, who already has several extended histories to draw from, but rather for the amateur. For this reason an attempt has been made to render it easily understood by anyone possessing elementary notions of cosmography.

The book is divided into four parts, dealing, respectively, with ancient, medieval, modern and present-day astronomy—although the last portion extends only to the middle of the last century.

The author analyzes the works of the astronomers in chronological order, and the present writer thinks he has done it well. The essential facts regarding the life of each person are given in an interesting way and his achievements are also explained in a clear and simple manner.

The book is easy to read, but one would soon tire if he attempted to read it directly through from first page to last. It is encyclopedic in nature and contains a great amount of information packed in its five hundred pages.

Its great and serious defect is the absence of an index. Without that its usefulness is limited.

C. A. C.

## NOTES AND QUERIES

**Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.**

### THE TOTAL ECLIPSE OF AUGUST 7, 1869

The great interest aroused by the recent eclipse called forth a number of letters to the newspapers referring to previous eclipses. Several of these related experiences at the time of the eclipse of August 7, 1869. In this case the shadow path crossed North America from Alaska to North Carolina and as the day was fine many valuable observations were made. It was at this eclipse that the existence of the distinctive green line in the spectrum of the corona was demonstrated and the name "coronium" given to the substance giving rise to it.

The present writer has received from Mr. J. A. McKellar, of Tiverton, Bruce County, Ont., a description of this eclipse, which is reproduced herewith.

The writer was fortunate to be residing in Payson, Ill., ten miles east of Hannibal, Mo., being employed, with others, on the Seaborn Farm comprising 20,000 acres. The Seaborn home was on the level lands 250 feet above the Mississippi valley. Hannibal city was on the river, which ran close to the Missouri side. The view from the home extended as far as the eye could carry on the treeless prairie. Mr. Seaborn asked us to quit work and view the eclipse from the steps of his home. August 7, 1869, was a most beautiful day—the sky clear, no wind. At shortly after 1 p.m. the moon began to creep across the sun and a weird light to spread over the view. Soon the eclipse became total. To the west the Missouri line faded out of sight, also our view over the prairies. The farm animals sensed something unusual and became restive and sought shelter in the farm buildings. The poultry came running in from the fields and flew up to their roosts. The birds in the trees stopped singing. A herd of horses in an adjacent field ran around the field. The coloured people in Mr. Seaborn's employ were troubled, and feared something was going to harm them—especially the domestics in the home. In fact we were all more or less affected by the dim, weird shadows around us. There was a ring or halo

of light given out by the sun, though no rays were visible. This ring was in quivering points, shooting outwards, though this did not seem to have any effect on the darkness and shadows over the country. The darkness seemed to last longer than it did on January 24, 1925. Stars appeared more numerous in the sky near the eclipsed sun. I did not notice if any were visible farther away. Another feature—the darkness was more pronounced in the 1869 eclipse than at the recent one. The shadow moved on and soon the darkness faded away; the birds began to sing; the fowl flew down from their roosts.

So passed the total eclipse of August 7, 1869. I was quite young at the time, and the thrill of the event will remain, and the hour spent in viewing the wonderful sight will not be forgotten while life lasts.

*Resolution of Appreciation*

The recent eclipse aroused extraordinary interest throughout the country, and from all quarters have been received expressions of regret that clouds prevented the University of Toronto expedition at Long's Corners from obtaining the photographs for which extensive preparations had been made.

One of the most highly valued communications, however, is from the secretary of the Board of Trade of Toronto containing the following resolution adopted at the Annual Meeting of the Board on Monday, January 26, 1925:—

"Resolved that the Board of Trade of the City of Toronto desires to place on record its appreciation and admiration of Prof. C. A. Chant and his associates for their efforts to obtain the very latest scientific results of the recent eclipse of the sun, and that there be extended to them a fellow-feeling in their keen disappointment over the weather and cloud conditions which nullified their heroic efforts."

*Log. Tables Again*

While in Hamilton during the preparations for observing the eclipse, Dr. Young and the writer had occasion to inquire at several bookstores for a book of mathematical tables. To the request for log. tables a small "Ready Reckoner" was produced,

which contained tables for computing the lumber in logs. When it was explained that tables of logarithms or mathematical tables were required, there seemed to be no better understanding of our needs. Finally on a shelf were found an ancient copy of Salmon's "Conic Sections" and a copy of Cherriman and Baker's "Trigonometry" published in 1883. Included in the latter were the tables desired and the book was purchased for twenty-five cents.

## RAINBOW OR HALO?

The *Ottawa Journal* on December 26, 1924, contained the following item:

> Residents of Aylmer and vicinity saw an unusual sight about four o'clock yesterday afternoon. In the direction of the setting sun, a gigantic rainbow, with its myriads of colour, was seen. The diffusion of the sun's rays through the rainbow formed one of the most beautiful nature pictures witnessed there in years. The rainbow was visible for some time, but with the fading sunlight dissolved into the atmosphere.

As this phenomenon was seen in the direction of the sun it could hardly have been a rainbow, but apparently it was a fine halo. On a previous page of this issue Mr. H. B. Collier describes a halo seen on January 26.

C. A. C.

# MEETINGS OF THE SOCIETY

## At Victoria, B.C.

October 16, 1924.—A regular meeting of the Society was held at 8 p.m. in Victoria College, the President, Mr. J. Duff, in the chair.

The address of the evening was given by Mr. W. H. Christie on "The Planet Mars." The lecturer sketched the history of the earlier observations, referring to the discovery by Schiaparelli of the "Canali" (which have been misinterpreted "canals"). The chief work on Mars in recent years has been done by Lowell and his colleagues at Flagstaff Observatory in Arizona. They have made certain of the existence of the canals, which are now supposed to be belts of vegetation, irrigated from the melting snowcaps. The seasonal changes of colour in the dark areas, the existence of an atmosphere and of a fairly high temperature, would seem to indicate that Mars is fitted to be the home of intelligent beings, though on account of its vast distance from us it is unlikely that their actual existence can be demonstrated. The address was illustrated by a large number of slides, and on its conclusion a hearty vote of thanks was given the lecturer.

F. MOORE, *Secretary.*

November 25, 1924.—A regular meeting of the Society was held at 8 p.m. in Victoria College, the President in the chair.

Owing to the regrettable illness of Mr. Moore, Mr. F. C. Green was appointed Secretary *pro tem.*

David Sturgeon, Rose Lake, B.C., was elected to membership.

The chairman then called upon Dr. J. S. Plaskett, who addressed the meeting on "The evolution of the stars." After sketching Laplace's nebular theory of the origin of the Solar System, and referring to its great influence on the scientific thought of the nineteenth century, the speaker showed how this theory had been unable to sustain the tests of modern mathematical and physical science. Moulton and Chamberlin's planetesimal hypothesis, enunciated about a century later, gave a more satisfactory explanation both of the origin of the numerous spiral nebulae revealed by celestial photography, and also of the origin of planets or even suns by the concentration of scattered matter around the separate nuclei seen in the curved arms of the nebulae. It has been shown by Jeans and others that a rotating nebula on contracting would reach a stage of instability, and that a ring of nebulous matter would be thrown off, and this was confirmed by observation of those spiral nebulae which are seen edgewise.

Some years ago it was generally held that the normal history of a star began with the excessively high temperature of the Orion stars, and that it passed with falling temperature through white, yellow (this being the solar type) orange and red to extinction. According to this view stars of the same temperature

and colour were of the same age. Lockyer, however, maintained that this was preceded by a stage of rising temperature, so that there was a progression from red to blue-white and back again to extinction. In recent years this idea was revived by Russell in his theory of Giant stars with increasing, and Dwarf stars with decreasing temperatures. This has been confirmed by Michelson's actual measurement of the diameter of Giants, some exceeding that of the whole orbit of Mars.

The lecture was illustrated by a fine series of slides depicting spiral nebulae, clouds of luminous and dark matter in space, and the life history of a star from the nebulous stage to extinction. After a full discussion and many questions asked, a hearty vote of thanks was tendered Dr. Plaskett and the meeting adjourned. F. C. GREEN, *Secretary pro tem.*

December 19, 1924.—The Annual Meeting of the Society was held at 8 p.m. in Victoria College, the President in the chair.

Ross Bewell, Prospect Lake, was elected to membership.

The President gave a review of astronomical research during the year 1924, of which the following is a synopsis.

## A REVIEW OF ASTRONOMY FOR 1924

*Celestial Events.*—Considerable interest was aroused by the transit of Mercury and the near approach of Mars. The sun-spot minimum occurred in 1923, but the old series of spots had a remarkable revival as recently as October and November of this year.

*Instrumental Facilities.*—The lack of large modern instruments in the southern hemisphere is being remedied by the erection of an observatory near the Rand in South Africa, the building of a 60-inch reflector for the Argentine and the setting up of two refractors from United States observatories at Bloemfontein and in New Zealand.

*Star Distances.*—An important advance has recently been made in the methods of sounding the depths of space. The apparent brightness of a star depends on three things: size, distance, and surface intensity, the last corresponding (at least roughly) to colour, as in the case of a heated piece of iron. Taking the limited number of stars whose distance is known we can eliminate the effect of their unequal *distances* and get their absolute magnitudes, that is, their light-giving power relatively to each other. The next step is to compare the light-giving power of several stars of the same colour, thus eliminating the effect of unequal *surface intensity*, so that *size* only is left. Adams discovered that in stars of the same stellar type or colour certain peculiarities in the spectral lines were associated with differences in the actual sizes of the stars, and these peculiarities when observed in the spectra of stars beyond the reach of ordinary methods, can be used as an index of their true brightness, and therefore their distances when their apparent brightness is taken into account. While nearly a century of effort up to 1916 gave only 200 star distances, the new method

during the last six or seven years has added 3,000 or more, most of them determined at Mt. Wilson and Victoria.

*The Smaller Magellanic Cloud.*—Shapley of Harvard, using the periods of Cepheid variables as an index of absolute magnitude, finds that this object is at a distance of 100,000 light-years, the estimated probable error being 15%, and is 6,500 light-years in diameter. It contains perhaps 300 stars over 50,000 times brighter than the sun and half a million over a hundred times brighter. It is receding from us at the rate of 100 miles a second.

*Planetary Research.*—The observers at Flagstaff using a delicate thermocouple have found that the radiation from Mars indicates temperatures as high as 65° F. At Mt. Wilson values somewhat lower have been obtained. Similar methods applied to Venus indicate a temperature of about zero. Interesting as these results are it is a little uncertain whether they tell us much about the temperatures of the solid surfaces of these planets or the possibility of life on them.

*Relativity.*—Evershed confirms St. John's observation of a shift of the solar spectrum lines towards the red. Lorentz has deduced from the theory a small additional precession, probably too small, however, to be tested by observation. T. J. J. See maintains that the bending of star rays by solar gravitation can be accounted for on the Newtonian theory, while Prof. Poor points out the possibility of abnormal refraction caused by the cooling of the air in the moon's shadow. De Sitter and Silberstein have calculated the diameter of the unbounded four-dimensional universe as 500 million million million miles, about ten times the estimated distance of the farthest visible nebula.

*High-density Gases in Stars.*—Eddington concludes that matter in the interior of a star may be far denser than the heaviest metals and yet behave as a gas. Intense ionization would mean the loss of many of the outer electrons of each atom, making closer packing possible.

*Criticism of Star Stream Theory.* Twenty years ago Kapteyn announced that the stars instead of flying at random through space were grouped in two great streams. This is now questioned by Charlier, who claims that too few star distances were known at that time for anyone to reach a valid conclusion on the matter.

*The Henry Draper Catalogue.*—A brief account was given of the wide scope of this work and its value to astronomers everywhere as a storehouse of material for various lines of research.

On the conclusion of the address the thanks of the Society were expressed by Dr. Plaskett and Mr. Harper.

Mr. Harper was asked to take the chair during the election of officers, and the following officers were unanimously elected for the ensuing year:

Honorary President: J. S. Plaskett, D.Sc., F.R.S.
President: J. Duff, M.A.
Vice-President: F. Moore.
Treasurer: J. P. Hibben.
Secretary: J. A. Pearce, M.A.

Council: K. M. Chadwick, R. G. Miller, P. H. Elliott, M.Sc., E. E. Blackwood, and Past Presidents F. Napier Denison, W. S. Drewry, J. E. Umbach, and W. E. Harper, M.A.

Much regret was expressed at the illness which forced Mr. Moore to relinquish the Secretaryship, and the Acting Secretary was instructed to write Mr. Moore expressing the thanks of the Society for his painstaking and efficient efforts in the past.

On motion the meeting adjourned.

F. C. GREEN, *Secretary pro tem.*

### At London

The regular October meeting was held in the University of Western Ontario on Friday, October 10th, 1924, at 8.15 p.m., Dr. H. R. Kingston presiding. The President and the Secretary were named a committee to make arrangements for holding the meetings of the Society in the London Public Library.

Dr. Kingston gave an illustrated address on "The Earth as an Astronomical Body." Dr. Kingston pointed out that the subject involves two major topics: (1) The earth considered by itself apart from the Solar System, its size, shape, rigidity, density, atmosphere, composition, etc. (2) The earth as a part of the Solar System, its motions, etc. He demonstrated by the use of "drawing" the fact that a knowledge of the size and shape of the earth is a necessary foundation for the study of the heavenly bodies.

The generally accepted proof that the earth is a sphere were reviewed and shown to be defective. For example, (1) a boat going out to sea appears to drop out of sight, the lower part being the first to disappear. This proves that the earth is curved. (2) It is possible to sail round the earth without a change of direction. This is true of a flat surface. (3) When the moon passes into the shadow of the earth the edge of the shadow is curved.

Dr. Kingston next proceeded to show that it is possible to give a satisfactory proof that the earth is spherical. If we examine a perfect sphere we find that the horizon should change in direction by an angle which is directly proportional to the distance travelled, regardless of the direction. When this result is checked up with the earth it is found to apply approximately. Further investigation shows that the earth is not a perfect sphere but an oblate spheroid. The length of a degree of latitude on the earth increases as we travel north or south from the equator which proves that the earth gets flatter.

November 14, 1924.—At the November meeting Dr. Kingston gave a second address on the same topic. He reviewed the work of the different astronomers in their efforts to measure the lengths of degrees of latitude and pointed out that these have been determined within a possible error of not more than 3 or 4 feet in one degree of latitude. Dr. Kingston next described with the help of blackboard drawings a simple though rather rough method for measuring the diameter of the earth. This consisted in selecting a fairly level stretch of country two miles in length. Three posts of equal height are placed in line, the posts being 1 mile apart. By using a surveyor's level the distance by which the post

projects above the level line joining the first and third posts is determined. This amount is then applied to a simple formula to calculate the length of the earth's diameter. Next the use of the pendulum was explained. A particle at the earth's equator travels as the earth rotates, faster than a particle located north or south of the equator since it travels in a larger circle. The faster a particle travels the greater its centrifugal force and therefore the less it will weigh. The change in the weight of a particle as it is taken north or south of the equator can be calculated on the assumption that the earth is a perfect sphere. When this change is checked up with the actual change in weight on the earth it is found there is a greater increase in weight than the theory allows, as the particle moves north or south. This discrepancy is due to the flattening of the earth. The usual formula connecting the value of gravity with the length of a pendulum and its time of oscillation was explained. Observations are made of the time of pendulums of equal length at different latitudes and the values of "g" are determined. From these values the amount of the flattening of the earth is determined.

### At Toronto

November 25, 1924.—A regular meeting was held in the Physics Building of the University, the Vice-President, Mr. A. F. Hunter, in the chair.

The main paper of the evening was presented by Mr. John A. Paterson, M.A., K.C. Mr. Paterson briefly reviewed the development of astronomical theory to the nebular stage, incidentally dealing with the question of the plurality of worlds, which he was inclined to regard in the affirmative, and found in nature, especially its features as revealed in astronomy, an expression of Divinity.

A second paper, dealing with "Daylight Saving Time" was presented by Mr. A. R. Hassard, B.C.L. In discussing the subject Mr. Hassard pointed out the necessity of the use of some sort of artificial method of diurnal time reckoning, and the impossibility of following nature too closely in such matters because of the inequalities that go to make up the varying days of the year. The question resolving itself largely into one of expediency.

The papers were discussed by several of the members. Prof. Chant thought the chief difficulty with daylight saving time was the want of uniformity in its adoption by various municipalities.

### At Montreal

December 17, 1924.—The President in the chair.

New members were elected as follows:

Dr. D. A. Keys
J. Newman Hall
J. Powell Davies
Mrs. J. Powell Davies
Miss Jane Fleet
Miss W. Eglaugh
Mrs. E. E. Traversy
Mrs. Bridgen
E. E. Watson
H. B. Hachey
A. S. MacIntosh

The lecture of the evening was given by Dr. A. S. Eve on "The Solar System and the Atom—a comparison and a contrast".

Beginning with the early conception of a flat earth the development of thought was traced through the centuries—Ptolemy with his geocentric system, Copernicus with his heliocentric system, Kepler with his three great laws of planetary motion in elliptic orbits, Newton with his law of universal gravitation.

Atomic thought has developed from the idea of a round, hard, solid atom to the first Bohr model, a nucleus with electrons in circular orbits about it, and then to the present model in which some of the orbits are elliptical and the three laws of Kepler hold true.

Slides were shown of the observatory of Tycho Brahe, whose painstaking observations formed the basis for the calculation of Kepler's Laws; and slides of the various members of the Solar System.

Bode's Law was then given, and, on the scale of 1 metre equal to 100,000,000 miles, the Solar System was set forth upon the blackboard to the orbit of Jupiter. The families of satellites were briefly described with reference to two authors—Swift, whose forecast of the moons of Mars was remarkable, and Jeffreys, whose recent book, *The Earth*, presents a masterly summary of present-day theories of cosmogony.

Before describing the atom experiments were made to indicate the existence of two kinds of electric charge, their attraction for one another and mutual repulsion. Coulomb's torsion balance was shown. The work of Crookes and J. J. Thomson and Rutherford was outlined leading up to the Rutherford-Bohr atom. The minuteness of size of the nucleus compared to its planet-like electrons was a contrast to the reverse state of affairs in the Solar System. The atomic phenomena of absorption and emission of light were explained and diagrams given to illustrate the atomic systems of various elements.

The subject of precession of orbits was then dealt with, first for the case of the planet Mercury whose orbit precesses one-third of a second per year due to the change of mass with change of velocity, the velocity change being one of the consequences of Kepler's second law. In the case of a planet-like electron revolving about its nucleus in a very much elongated orbit, the velocity is so great in the small portion of the orbit near to the nucleus that the change of mass is tremendous and the precessional effect may be as much as 120 .

In conclusion it was pointed out that the present model of the atom, though acceptable to the physicist and in particular to the spectroscopist, is not equally satisfactory to the chemist and in the future will probably be modified in some as yet unforeseen way.

A vote of thanks was moved by Col. W. E. Lyman, who desired also that it be placed on record that this Society appreciates very highly the time, thought and energy expended by Dr. A. S. Eve in the interest of the Society during the past few years and in particular during the past few months since the death of the late Secretary-Treasurer.

This motion was warmly supported by the President and carried unanimously. The meeting adjourned. A. VIBERT DOUGLAS, *Secretary.*

# The Royal Astronomical Society of Canada

(OFFICERS FOR 1924—REVISED TO MARCH 1ST, 1924)

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